

Energy In The Ecosystem

Standards Addressed

Environmental Education Standards:

- A. Questioning and Analysis: A.4.1, A.4.2, A.4.3, and A.4.4.
- B. Knowledge of Environmental Processes and Systems: B.4.1, B.4.3, B.4.4, and B.4.6.

Science Standards:

- A. Science Connections: A.4.1, A.4.3, and A.4.4.
- C. Science Inquiry: C.4.1, C.4.2, C.4.4, C.4.5, C.4.6, C.4.7, and C.4.8.
- D. Physical Science: D.4.8.

Key Concepts/ Content

- 🌲 To understand heat absorption, transfer of heat energy, and how heat affects colors.
- 🌲 To understand which colors found in a forest ecosystem will absorb the most heat energy.
- 🌲 To use inquiry to investigate questions about energy in a forest ecosystem.

Teacher Background

The Role of Sunlight Energy in the Practice of Forestry

In many respects the practice of forest management is largely the control of sunlight and the energy it radiates on the ground and trees. Foresters control the density of forest canopys to allow just the right amount of sunlight to reach the forest floor to encourage new trees to germinate and grow. Too much energy from the sun will evaporate the moisture needed by young trees.

Each species of tree, such as white pine, aspen, or red oak requires different sunlight (energy) levels to thrive. Aspen, for instance, needs lots of sunlight and heat to sprout and grow into mature trees. Aspen cannot tolerate shade and it will die if other trees shut out the sunlight. It is a tree that thrives after the soil has been disturbed.

White pine, on the other hand, can germinate and grow in partial shade. If foresters want to encourage and grow white pine, they thin the tree crowns (by tree removal) and let more sunlight through to reach the forest floor.

The following chart will give you some idea of how tree characteristics vary and why the forester has to consider the needs of each tree species when managing the forest:

Species	Shade tolerance	Seed/lb	Seed fall	Germ. temp.
Sugar maple	Very tolerant	6,100	Sept.	34° F
Basswood	Tolerant	5,000	Sept.-Oct.	40° F
Red maple	Tolerant	22,800	May-June	40° F
White ash	Intermediate	10,000	Sept.-Dec.	34-64° F
Yellow birch	Intermediate	447,000	Oct.-Dec.	60° F
Red oak	Intermediate	140	2 nd Sept.	34° F
Aspen	Intolerant	Numerous	May	50+° F

As you can see, sunlight (and the energy it provides) is very important in the growth and development of the forest. Large seeds, like those from red oak, can penetrate through leaves on the forest floor to reach moist soil and germinate. Aspen seeds need exposed soil to establish their root system because they are so small. Too much sunlight and not enough rain will prevent new trees from becoming established.

Getting Ready

Students should have a working knowledge of what defines an ecosystem (a large part of the earth with similar climate, land, plants, and animals) and a habitat (a small part of an ecosystem with similar land, climate, and organisms). Students should be aware that color is a natural part of the environment of any ecosystem and that it may be a part of an organism's ability to produce food as in most plants or serve as a method to attract a mate or protect an organism as in most animals.

Students may know that dark colors tend to absorb heat, while lighter ones tend to reflect heat.

Discussion may lead to the dark soil absorbing heat in spring helping to germinate seeds and promote plant growth, while snow reflects away heat in winter.

Safety Issues



Remind students to be careful when cutting. If you use a heat lamp, be careful not to place it too close to the boxes and remind students to keep away from the lamp.

Materials Needed

- ✦ Construction paper: a variety of colors (green, yellow, gray, brown) as well as black and white (other colors may be used as inquiry)
- ✦ Scissors
- ✦ Rulers
- ✦ Glue
- ✦ Thermometers
- ✦ Graph paper
- ✦ Small boxes or lids from boxes (shoe boxes and/or their lids)
- ✦ Aluminum foil, optional
- ✦ Student-suggested materials not listed here

Procedures

1. Divide the class into cooperative groups and assign roles (recorder, measurer, cutter, gluer, drawer, etc.). In smaller groups, students may have more than one role or duty to perform.
2. Ask the students what they know about the colors you are holding.
3. Show students all the colors of construction paper that you have. Discuss what objects and organisms in forests have those colors. Then, in groups, have them predict which colors will absorb the most heat, and write the order from least to greatest, reminding them that this is their hypothesis.

4. Then have each group discuss a way in which they could test their hypothesis. (You may accept alternative methods allowing students the freedom to explore a variety of solutions to the problem. You may limit the choices to materials on hand or available to you. Not all groups need to do the same thing. This is what leads to good inquiry.)
5. One suggestion is to cover the sides of a small box with aluminum foil. This may need to be glued down. Then, cut each piece of construction paper to fit the bottom of the box. Place a thermometer in the center of the box and place in the sun for 15 to 20 minutes and record the temperature. (To get accurate results, you may wish to use a sunlit place on a window sill in the classroom or a place out of the wind outside. A sunlamp may be substituted if natural sunlight is not available.) Repeat with each color for exactly the same amount of time.
6. Record data and compare to the student's hypothesis.
7. Discuss results with other groups and compare data. Discuss reasons for differences in data.
8. Suggest alternative methods of gathering data or re-testing if necessary.

Hints

Instead of each group in the classroom testing each color, you may choose to have each group test one or two colors.

If the temperatures do not seem to vary much, place the thermometer **under** the construction paper placed in the bottom of the box.

Evidence of Student Understanding

Students should find that black will absorb the most heat, and white the least. The other colors, depending on, which ones are used, should fall in between, ranging from darker intensities to lighter ones. Ask the students to explain how their results would apply to the colors found in a forest.

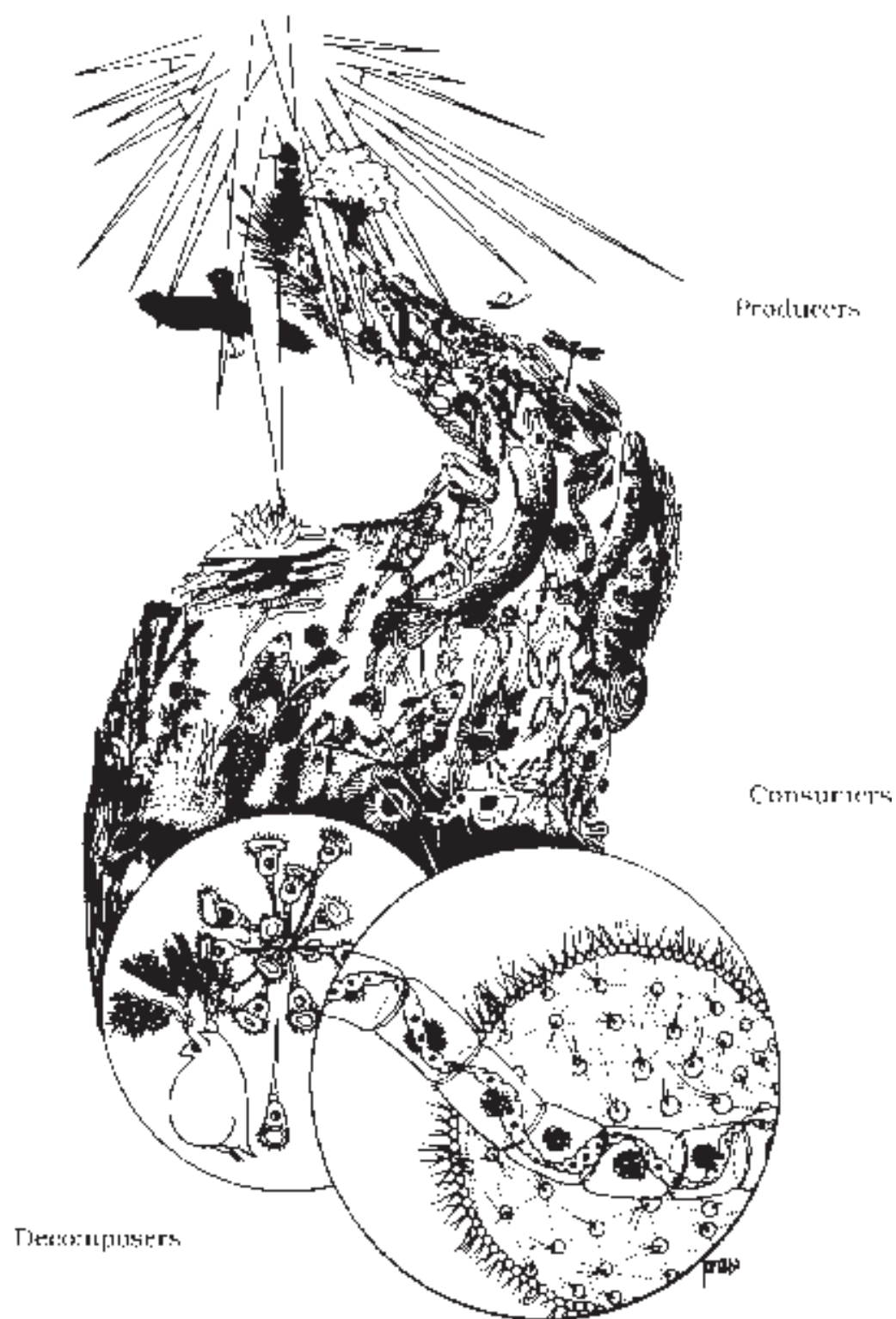
Extensions

- Have students graph their results with temperatures on the vertical axis and colors, from least to greatest, on the horizontal axis. Using a bar graph, students may choose to color each bar with the appropriate color, or color code the words as they appear on the horizontal axis.
- Have students design and build a diorama that would represent a “warm” or “cool” ecosystem or habitat depending upon the findings of the exercise and plants and animals that would inhabit it.
- Have students report on their findings from the activity, show their graphs, and explain why some habitats or ecosystems are warmer or colder than others.

Activity Sheet

Energy in the Ecosystem

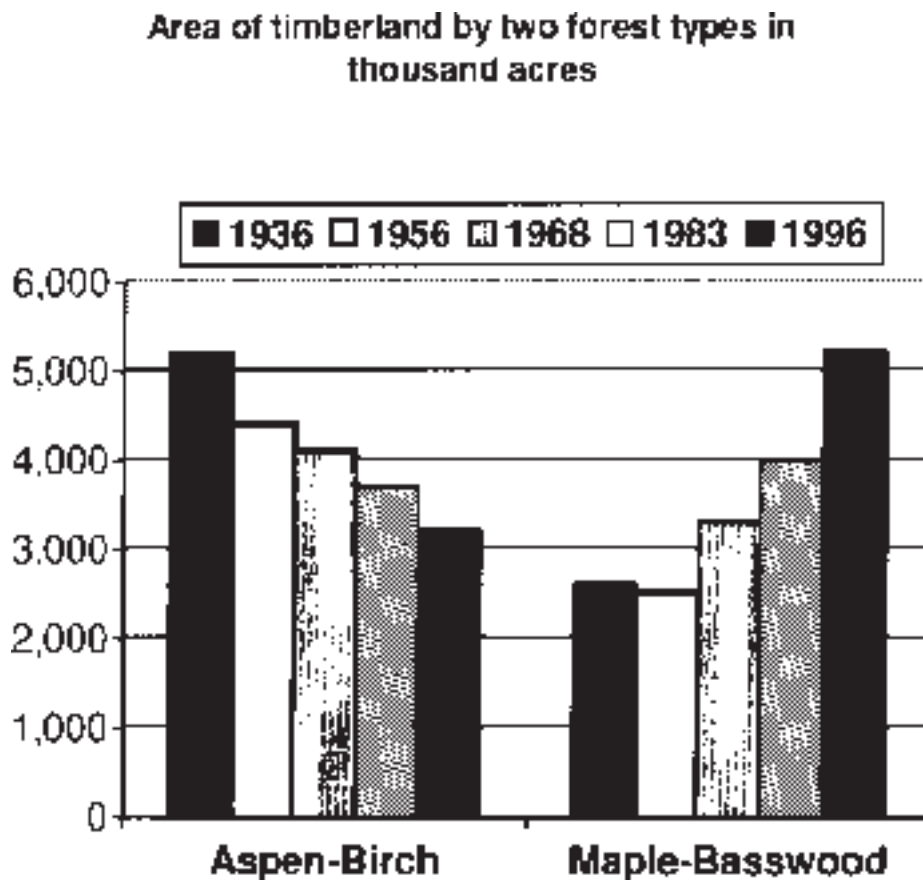
Sun



Energy in the Ecosystem

Extension:

Real Forestry Example



Look at the above graph.

Which forest type is declining?

Which forest type is increasing?

If you were an aspen seed would you prefer shade or sunlight?

Can you think of reasons why there are fewer aspens?

